FEASIBILITY STUDY REPORT

Eagle Zinc Company Site
Hillsboro, Illinois

Submitted to:

United States Environmental Protection Agency, Region 5
and
Illinois Environmental Protection Agency

Submitted by:

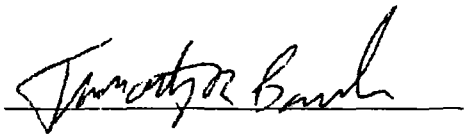
ENVIRON International Corporation
Deerfield, Illinois

On behalf of:

Eagle Zinc Parties

March 2006

Under penalty of law, I certify that, to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of this Report, the information submitted is true, accurate, and complete.



Timothy R. Barber, Ph.D.
Project Coordinator
Eagle Zinc Company Site

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ENVIRON

March 20, 2006

Mr. Dion Novak
Superfund Division
United States Environmental Protection Agency
77 West Jackson Boulevard (Mail Code: SR-6J)
Chicago, IL 60604

Re: Revised Feasibility Study Report
Remedial Investigation/Feasibility Study
Eagle Zinc Company Site, Hillsboro, Illinois

Dear Mr. Novak:

Enclosed please find the revised report entitled *Feasibility Study Report* for the Eagle Zinc Company Site. If you have any questions concerning this submission, please do not hesitate to contact us.

Sincerely,

ENVIRON International Corporation

F. Ross Jones

F. Ross Jones, P.G.
Manager

FRJ:rms

Enclosure

cc: Thomas Krueger, Esq. – USEPA Region 5
Mr. Rick Lanham – IEPA Bureau of Land
Ms. Lisa Cundiff – CH2M HILL
John Ix, Esq. – Dechert
Lois Kimbol, Esq. – Dechert
Mr. Paul Harper – Eagle-Picher
Mr. Gordon Kuntz – Sherwin-Williams
Mr. Tim Barber – ENVIRON International Corporation
Mr. Jeff Margolin – ENVIRON International Corporation

LIST OF ACRONYMS

AOC	Administrative Order on Consent
ARARs	Applicable or Relevant and Appropriate Requirements
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPCs	Constituents of Potential Concern
ENVIRON	ENVIRON International Company
ERAs	Ecological Risk Assessments
FS	Feasibility Study
HHRAs	Human Health Risk Assessments
HI	Hazard Index
IEPA	Illinois Environmental Protection Agency
LDRs	Land Disposal Restrictions
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NCP	National Contingency Plan
O&M	Operations and Maintenance
RI/FS	Remedial Investigation/Feasibility Study
RAOs	Remedial Action Objectives
RBCs	Risk Based Concentrations
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act
SOW	Statement of Work
TBCs	To Be Considered(s)
TSDF	Treatment, Storage, and Disposal Facility
TCLP	Toxicity Characteristic Leaching Procedure
USEPA	United States Environmental Protection Agency

I. INTRODUCTION

This report documents the results of a Feasibility Study (FS) conducted for the former Eagle Zinc Company Site (the "Site"). The location of the Site property is shown on Figure I-1 and a generalized Site layout map is presented as Figure I-2. ENVIRON International Corporation (ENVIRON) has prepared this report on behalf of the Eagle Zinc Parties (the "Parties") as part of the Remedial Investigation/Feasibility Study (RI/FS) for the Site. The RI/FS is being completed pursuant to the Statement of Work (SOW) contained in the December 31, 2001 Administrative Order on Consent (AOC) between the Parties and the United States Environmental Protection Agency (USEPA).

Consistent with the goals of the FS, as stated in the SOW and RI/FS Work Plan, the primary objective of the FS is to evaluate remedial alternatives applicable to addressing contaminant concentrations above the Site remediation goals. The following documents previously submitted to and approved by the USEPA,[1] provide supporting documentation for certain aspects of the FS:

- *Preliminary Site Evaluation Report, March 2002* (the "PSE Report")
- *Remedial Investigation/Feasibility Study Work Plan, July 2002* (the "RI/FS Work Plan")
- *Technical Memorandum, Phase 1 - Source Characterization, March 2003* (the "Phase 1 Technical Memorandum")
- *Technical Memorandum, Phase 2 - Migration Pathway Assessment, November 2003* (the "Phase 2 Technical Memorandum")
- *Human Health Risk Assessment, August 2004* (the "HHRA")
- *Ecological Risk Screening Evaluation, August 2004* (the "ERSE")
- *Remedial Investigation Report, February 2005* (the "RI Report")
- *Addendum to Remedial Investigation Report, February 2006* (the "RI Addendum")

Section II of this report presents a summary of the baseline human health and ecological risk assessments, including the primary conclusions from the RI Report and RI Addendum. Section III contains the identification of remedial action objectives (RAOs) and applicable or relevant and appropriate requirements (ARARs). Section IV identifies and screens potentially applicable remedial technologies. Section V provides a detailed analysis of the alternatives. Section VI presents the comparative analysis of the alternatives. Section VII presents the recommended alternative and Section VIII presents the documents referenced in this report.

This FS report has been prepared to be consistent with USEPA guidance entitled *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988a)

[1] As of the date of this report, final approval of the RI Addendum has not been issued by USEPA.

as applicable. As such, this FS Report documents the development and evaluation of remedial alternatives for the Site. These remedial alternatives are based in part on the present idle condition of this industrial Site and in part on the reasonably anticipated use of the Site for industrial/commercial purposes (including disturbance of the residue piles).

II. SUMMARY OF BASELINE RISK ASSESSMENT

Human health risk assessments and ecological risk assessments (HHRAs and ERAs) were prepared for the Site and submitted to USEPA as part of the RI Report and RI Addendum (ENVIRON, 2005 and 2006, respectively).[2] The HHRAs evaluated potential risks associated with Site-specific constituents of potential concern (COPCs) associated with the historic Site operations.[3] Similarly, the ERAs evaluated potential risks to ecological receptors. The risk assessments for this Site were prepared in accordance with current USEPA guidance. The findings of the HHRAs and ERAs are summarized below.

A. Risks to Human Health

The HHRAs quantitatively evaluated potential cancer risks and noncancer hazards posed by exposure to site-specific COPCs in the impacted (and potentially impacted) media, including soil, groundwater, surface water, sediment, residue pile material, and air. The potential receptors evaluated were on-site industrial/commercial workers, on-site construction workers, trespassers, off-site residents, and off-site recreators (bathers and fishers in Lake Hillsboro). The exposure routes that were quantitatively evaluated for the identified media and receptors were ingestion, dermal contact, and inhalation (as appropriate for each medium/receptor combination).

The results of the HHRAs presented in the RI Report and RI Addendum indicated that under current and reasonably anticipated use exposure scenarios there are no cancer risks or noncancer hazards above the levels specified in the National Contingency Plan (NCP). At the request of the USEPA, a worst-case scenario in which the analytical data from the piles were compared to the USEPA Region 3 default Risk Based Concentrations (RBCs) was evaluated in the RI Addendum which indicated that arsenic and lead in some of the residue pile materials may be associated with cancer risks or noncancer hazards above the levels specified in the NCP.

Also at the request of USEPA, CH2M HILL (USEPA, 2005a) conducted a human health evaluation using two major assumptions: that residue material covers the entire Site and drainageways and the characteristics of all residue material can be approximated by the <75 micron fraction. Based on these assumptions, the human health evaluation indicated that risks above the levels specified in the NCP may be associated with commercial/industrial workers. ENVIRON disagrees with the above assumptions as residue materials do not cover the entire Site and the <75 micron fraction only represents 3-5%of the residue pile materials. Nevertheless, CH2M HILL's conclusions are used in the evaluations in this FS.

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[2] The risk assessments were supplemented by additional evaluation completed by EPA (and its contractors) as documented in the EPA comment letter dated December 22, 2005. The EPA has not yet approved the risk assessments presented in the RI Addendum.

[3] The Site history and background information has been summarized in the previously submitted reports that are referenced in Section I.

B. Ecological Risks

The ERAs quantitatively evaluated potential ecological risks posed by exposure to site-specific COPCs in the impacted (and potentially impacted) media, including soil, surface water, sediment, residue pile material, and tissue. The potential receptors evaluated in the ERAs were sediment-dwelling (benthic) invertebrates, fish, deer mouse, American robin, red-tailed hawk, mink, and great blue heron. The results of the ERAs indicated that, under current and reasonably anticipated scenarios, none of the exposure scenarios evaluated were associated with ecological risks of concern.

At the request of USEPA, CH2M HILL (USEPA, 2005a) conducted an ecological evaluation using two major assumptions: that residue material covers the entire Site and drainageways and the characteristics of all residue material can be approximated by the <75 micron fraction. Based on these assumptions, the ecological evaluation indicated that ecological risks of concern may be associated with ecological receptors. ENVIRON disagrees with the above assumptions as residue materials do not cover the entire Site and the <75 micron fraction only represents 3-5% of the residue pile materials. Nevertheless, CH2M HILL's conclusions are used in the evaluations in this FS.

III. IDENTIFICATION OF REMEDIAL ACTION OBJECTIVES AND ARARs

A. Introduction

As the results of the RI process indicate that there are certain potential human health risks associated with certain residue pile materials at the Site under certain future scenarios, the identification and screening of technologies will be based on the review of the remedial action objectives (RAOs) developed for the Site and potential ARARs, potential standards to be considered (TBCs), and the need to maintain current and reasonably anticipated use scenarios.

B. Remedial Action Objectives

RAOs are developed as site-specific objectives for the purpose of protecting human health and the environment. Once RAOs are designed, they serve as a basis for the development of remedial action alternatives, necessary to meet the remediation goals. The RAOs for the Site are based on the findings of the RI Report and RI Addendum, including the HHRAs and ERAs, as well as a review of the ARARs and TBCs. The RAOs for the Site are as follows:

- Reduce calculated human health risks to below the carcinogenic risk level of $1x10^{-5}$ and the noncarcinogenic hazard index (HI) of 1 as specified in the NCP.
- Reduce lead concentrations to below concentrations associated with potential blood lead burdens considered to be potentially harmful to women of child-bearing age.
- Maintain ecological populations and/or communities.
- Maintain and ensure current and reasonably anticipated use scenarios for the Site including idle and/or industrial/commercial.

1. Human Health Remediation Goals

Calculation of remediation goals based on the human health RAOs presented above results in an arsenic remediation goal of 39 milligrams per kilogram (mg/kg) and a lead remediation goal of 1,288 mg/kg.[4] The arsenic remediation goal was calculated for industrial soils with a target cancer risk of $1x10^{-5}$ and a soil ingestion rate of 50 milligrams per day. The pathways considered in the arsenic remediation goal include ingestion, inhalation, and dermal absorption. Calculation of the arsenic remediation goal is presented in Appendix A. The lead remediation goal was calculated using the methodology presented in *Blood Lead Concentrations of U.S. Adult Females: Summary Statistics from Phases I and II of the National Health and Nutrition Evaluation Survey (NHANES III)* (USEPA, 2002).

[4] The lead remediation goal is based on lead concentrations associated with potential blood lead burdens considered to be potentially harmful to women of child-bearing age.

2. Piles with Concentrations above Human Health Remediation Goals

Based on the data presented in Table III-1, piles MP1-21 and RCO-10 have concentrations of arsenic and lead above their respective remediation goals. Piles RR2-11 and RR1-3 have concentrations of lead above the lead remediation goal. Piles MP1-21, RR2-11, and RR1-3 also contain residue materials that have toxicity characteristic leaching procedure (TCLP) lead concentrations above 5.0 milligrams per liter (mg/L).

C. Discussion of ARARs and TBCs

If contaminant concentrations above selected remediation goals are identified at the Site, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by Superfund Amendments and Reauthorization Act (SARA), requires the selection of a remedial action that is protective of human health and the environment. If a remedy is necessary to address contaminant concentrations above selected remediation goals, USEPA defines protectiveness based on comparison to a baseline risk assessment that considers both ARARs and TBCs.

A requirement may be either applicable or relevant and appropriate but not both. According to the *CERCLA Compliance With Other Laws Manual* (USEPA, 1988b), "applicable requirements are defined as those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site." Relevant and appropriate requirements are "those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to a particular site."

There are three types of ARARs and TBCs applicable to response actions: chemical-specific, location-specific, and action-specific. A brief description of each is provided below.

1. Chemical-Specific ARARs and TBCs

Chemical-specific ARARs are usually health- or risk-derived numerical values that establish an acceptable level or concentration of chemicals that may remain in specific environmental media after remediation is complete. These levels are used to help establish remedial cleanup goals. As a general rule, if more than one chemical-specific ARAR exists for a particular contaminant, the most stringent should be applied (USEPA, 1988b). Table III-2 lists chemical-specific ARARs for the Site.

The use of groundwater at the Site and off-site is restricted by a local ordinance.[5] As the Illinois Environmental Protection Agency (IEPA) allows for the exceedance of the Illinois Groundwater Protection Act standards in certain situations where institutional controls or local ordinances restrict groundwater usage, the Groundwater Protection Act is not applicable but is considered to be relevant and appropriate. Exceedances of the Illinois Groundwater Protection Act Standards are presented in Figure III-1.

As the drainageways at the Site are only intermittent, the drainageways are not considered to be jurisdictional waters of the state. Exceedances of the surface water standards (the Illinois Water Quality standards) are only evident in the samples collected closest to the Site. Surface water samples collected in the drainageways furthest from the Site do not show exceedances of the standards. Thus, the Water Quality Standards are not applicable but are considered to be relevant and appropriate. Exceedances of the Illinois Water Quality Standards are presented in Figure III-2.

2. Location-Specific ARARs and TBCs

Location-specific ARARs are restrictions on the concentration of hazardous substances or the conduct of activities in environmentally sensitive areas. An example of a location-specific restriction on the concentration of hazardous substances is the Resource Conservation and Recovery Act (RCRA) land disposal restrictions (LDRs) prohibiting hazardous waste placement into or onto the land (e.g., landfills) until waste-specific treatment standards are met. Examples of restrictions on the conduct of activities in environmentally sensitive areas include restrictions on activities in floodplains, wetlands, and locations where endangered species or historically significant cultural resources are present. Location-specific ARARs for the Site are listed on Table III-3. The location-specific ARARs and TBCs are not alternative specific.

3. Action-Specific ARARs and TBCs

Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions or conditions taken with respect to specific hazardous substances. Action-specific ARARs do not determine the remedial alternative; rather, they indicate how a selected alternative must be achieved. Table III-4 lists potential action-specific ARARs for the Site. The action-specific ARARs and TBCs are determined for each alternative.

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[5] The local ordinance states that "any connection whereby a private, auxiliary or emergency water supply other than the regular public water supply enters the supply or distribution system or the City..." is prohibited. This ordinance precludes the use of a separate domestic well water system within a household that is connected to the municipal water system.

IV. IDENTIFICATION AND SCREENING OF TECHNOLOGIES

A. General Response Actions

General response actions identified for the Site include:

- **No Action** – This response action category serves as a basis against which other remedial actions are compared and may be selected where current and future risks are negligible.

- **Institutional Controls** – Institutional controls are not intended to reduce the toxicity, mobility, or volume of hazardous site constituents, but to reduce potential exposure to those constituents. This response action may include administrative controls to place restrictions on Site development and to restrict access to the Site.

- **Treatment Technologies** – The purpose of a treatment technology, when used alone or in conjunction with a containment technology, is to reduce the volume, toxicity and/or mobility of site contaminants. Remedial treatment technologies include biological, physical, chemical, and thermal processes or some combination of those processes. Treatment technologies involving reclamation/recovery or immobilization have been identified by USEPA as Presumptive Remedies for "Principal Threat" wastes at metals-in-soil sites (USEPA, 1999). While the residue pile materials at the Site are not metals-impacted soils, the Metals-in-Soil Presumptive Remedy is generally applicable to these materials. Based on the experience of the Eagle Zinc personnel, reclamation/recovery technologies have not been practicable for the residue piles remaining at the Site, although investigation continues. Therefore, immobilization treatment technologies will be evaluated for residue pile materials identified as potential Principal Threat wastes, defined as those residue pile materials containing potentially leachable lead concentrations.

- **Containment Technologies** – A containment response action does not reduce the volume or toxicity of the contaminants in the site media. The purpose of this response action is to reduce contaminant mobility, and in doing so, minimize exposure and reduce potential hazards at the site. Containment, in the form of vertical or horizontal barriers, has been identified by USEPA as a Presumptive Remedy for "Low-Level Threat" wastes at metal-in-soil sites. Containment systems can provide sustained isolation of contaminants and provide a stable surface over wastes, limit direct contact, and improve aesthetics. While the residue pile materials at the Site are not metals-impacted soils, the

Metals-in-Soil Presumptive Remedy is generally applicable to these materials. Therefore, containment is evaluated as an alternative for residue pile materials identified as "Low-Level Threat" wastes, defined as those residue pile materials that contain contaminant concentrations above the Site remediation goals, but do not contain potentially leachable lead concentrations.

- **Disposal** – Disposal technologies involve off-site or on-site disposal of contaminated media or products of treatment processes. Disposal technologies do not usually involve reduction of contaminant volume or toxicity, but are primarily intended to reduce contaminant mobility. Off-site disposal options include transportation of the waste to a permitted treatment, storage, and disposal facility (TSDF).

B. Screening of Technologies

All of the General Response Actions listed above are relevant to the site and have been carried through to the Detailed Analysis of Alternatives presented below. The No Action response action must be evaluated in all feasibility studies and has been carried through to the alternatives analysis as a benchmark by which other alternatives are evaluated. The Institutional Controls response action is applicable to the Site, as certain potential risks are present which could, in part or entirely, be mitigated through the use of institutional controls. Treatment technologies are relevant with respect to potential leaching of lead from residue pile materials that exhibit the Characteristic of Toxicity for lead based on TCLP analysis. Containment and on- or off-site disposal are relevant, as these response actions limit direct exposure to residue pile materials that contain contaminant concentrations above the Site remediation goals.

C. Identification of Remedial Action Alternatives

1. Alternative 1 – No Action

The NCP requires that a No Action alternative be incorporated into the evaluation and selection of a remedial action. The No Action alternative serves as a point of comparison to the other alternatives under consideration at the Site. This alternative assumes that no remedial technologies will be implemented at the Site. No remedial technologies or engineering/institutional controls would be implemented and the exposures at the Site would remain unchanged in the near and long-term under the No Action alternative.

2. Alternative 2 – Institutional Controls

Institutional controls to maintain industrial/commercial use have been implemented and recorded as deed restrictions for the Site.[6] To further protect human health, the existing deed restrictions would be expanded to prohibit (without prior agency approval) or regulate disturbance of the residue pile materials and demolition of the buildings. Potential trespassing would be mitigated by installation and maintenance of a fence around the formerly active areas of the Site. A local ordinance is in effect that restricts the use of groundwater for potable purposes at the Site and in the vicinity of the Site.

The five-year CERCLA review process would be used to ensure that the physical conditions of the drainageways have not changed such that potential ecological risks of concern develop.

3. Alternative 3 – On-Site Treatment of Leachable Residue Pile Materials Using Immobilization Technologies, On-Site Containment of Selected Residue Piles, and Institutional Controls

Immobilization technologies would be used to reduce the leachability of lead in certain residue pile materials. Following treatment of selected residue pile materials, the residue piles that contain contaminant concentrations above the Site remediation goals would be consolidated and contained on-Site. Institutional controls would also be utilized to maintain protectiveness. Specifically, the existing deed restrictions would be expanded to prohibit (without prior agency approval) or regulate disturbance of the residue pile materials and demolition of the buildings and a fence would be installed around the formerly active areas of the Site.

Immobilization has been identified by USEPA as one of two treatment technologies for "Low-Level Threat" wastes in the Metals-in-Soil Presumptive Remedy. Immobilization includes processes that change the physical or chemical properties that impact the leaching characteristics of a treated waste or decrease its bioavailability and concentration. The reagents used to solidify or stabilize the materials are selected based on material characteristics and the metal contaminants present. The treatment can be performed *ex situ* or *in situ*, either on site or off site. Immobilized materials are generally managed in landfills or within appropriate containment barriers. It is anticipated that for certain residue pile materials at the Site (i.e. piles MP-21, RR2-11, and RR1-3), phosphatic agents, for example, that react with lead to form insoluble salts would be used to reduce the leachability of the lead. Bench-scale treatability testing is typically performed to determine the optimal amount of additives that will effectively reduce the leachability of the material and minimize volume increase of the treated material.

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[6] A deed restriction for Industrial/Commercial Use has been approved by the USEPA and recorded on the property deed.

Following immobilization treatment, residue piles that contain contaminant concentrations above the Site remediation goals (piles MP1-21, RR2-11, RR1-3, and RCO-10) would be consolidated at a single on-Site location and covered with an erosion control mat (e.g., geotextile material) followed by clean soil. The soil cover would be stabilized by vegetating with native plants and grasses. During remedy construction, best management practices would be implemented to manage stormwater runoff at the Site.

4. Alternative 4 – On-Site Treatment of Leachable Residue Pile Materials Using Immobilization Technologies, Off-Site Disposal of Selected Residue Piles, and Institutional Controls

This alternative includes on-Site treatment of leachable residue pile materials, removal and off-site disposal of residue piles that contain contaminant concentrations above Site remediation goals, and use of institutional controls. Residue materials in piles MP1-21, RR2-11, and RR1-3 will be treated on-site to reduce the leachability of lead using immobilization technologies. Following treatment, the treated residue pile materials and the residue material from pile RCO-10 will be removed and disposed in a state-permitted solid waste landfill (estimated pre-treatment volume of 15,700 cubic yards). Institutional controls would also be utilized to maintain protectiveness. Specifically, the existing deed restrictions would be expanded to prohibit (without prior agency approval) or regulate disturbance of the residue pile materials and demolition of the buildings and a fence would be installed around the formerly active areas of the Site.

5. Alternative 5 – Off-Site Disposal of Selected Residue Piles and Institutional Controls

This alternative includes off-site disposal of residue piles that contain contaminant concentrations above the Site remediation goals (piles MP1-21, RR2-11, RR1-3, and RCO-10) and use of institutional controls. Residue pile materials in pile RCO-10 would be removed and disposed in a state-permitted solid waste landfill (estimated volume of 5,600 cubic yards). Residue pile materials in piles MP1-21, RR2-11, and RR1-3 would be removed and disposed in a RCRA Subtitle C hazardous waste landfill (estimated volume of 10,100 cubic yards). Institutional controls would also be utilized to maintain protectiveness. Specifically, the existing deed restrictions would be expanded to prohibit (without prior agency approval) or regulate disturbance of the residue pile materials and demolition of the buildings and a fence would be installed around the formerly active areas of the Site.

V. DETAILED ANALYSIS OF ALTERNATIVES

A. Introduction

The purpose of the detailed analysis is to evaluate the relative performance of all alternatives using seven of the specific evaluation criteria. The two threshold criteria and the five primary or balancing criteria provide the basis for the comparative analysis. The two additional criteria are considered modifying criteria and are generally evaluated following regulatory agency and public comment on the RI/FS.

Threshold Criteria:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs

Balancing Criteria:

- Long-term Effectiveness and Permanence
- Reduction in Toxicity, Mobility, and/or Volume
- Short-term Effectiveness
- Implementability
- Cost

Modifying Criteria:

- State Acceptance
- Community Acceptance

B. Individual Analysis of Alternatives

1. Alternative 1 – No Action

Overall Protection of Human Health and the Environment

Since the No Action alternative does not affect future exposure scenarios and would not include the existing deed restrictions prohibiting non-industrial/commercial use, it does not address potential future human health and ecological risks.

Compliance with ARARs

The No Action alternative would not achieve the chemical-specific ARARs and TBCs for this Site. As this alternative does not involve any remedial actions, it would achieve the action-specific and location-specific ARARs and TBCs.

Long-term Effectiveness and Permanence

The effectiveness and permanence of the No Action alternative are poor based on the hypothetical future exposure routes assumed by CH2M HILL.

Reduction in Toxicity, Mobility, and/or Volume

The No Action alternative does not result in the reduction of toxicity, mobility, and/or volume.

Short-term Effectiveness

Short-term effectiveness does not apply to the No Action alternative.

Implementability

There are no technical or administrative implementability concerns associated with the No Action alternative.

Cost

There are no costs associated with the No Action alternative.

2. Alternative 2 – Institutional Controls

Overall Protection of Human Health and the Environment

Institutional Controls are protective under current and reasonably anticipated use scenarios.

Compliance with ARARs

The Institutional Controls alternative would comply with chemical-specific ARARs and TBCs, as the institutional controls would prevent any risks above those levels specified in the NCP. As the only active remedial component of this alternative is fencing, this alternative would achieve the action-specific and location-specific ARARs and TBCs.

Long-term Effectiveness and Permanence

The Institutional Controls alternative provides long-term effectiveness.

Reduction in Toxicity, Mobility, and/or Volume

Reduction in toxicity, mobility and/or volume is not applicable to Alternative 2 under the current and reasonably anticipated use scenarios as there are no risks above

those specified in the NCP. Under the hypothetical worst-case future scenarios as proposed by CH2M HILL, Alternative 2 would not achieve this criterion.

Short-term Effectiveness

The Institutional Controls alternative provides short-term effectiveness.

Implementability

There are no anticipated implementability issues with the Institutional Controls alternative.

Cost

Costs for deed recording of a Site Institutional Control that restricts Site use to industrial/commercial have already been incurred. Additional costs would be incurred to expand the existing institutional control. Capital costs for fencing and for expanding the additional institutional control are estimated to be $201,000. The net present value for Alternative 2 including 30 years of annual maintenance and CERCLA 5-year reviews is estimated to be $446,000.

3. Alternative 3 – On-Site Treatment of Leachable Residue Pile Materials Using Immobilization Technologies, On-Site Containment of Selected Residue Piles, and Institutional Controls

Overall Protection of Human Health and the Environment

Protectiveness is achieved by reducing the ability of the contaminant to migrate. Contamination remains on site, but the risk of exposure to human health receptors is significantly reduced through engineered barriers.

Compliance with ARARs

Activities to be implemented under Alternative 3 would be conducted in such a manner to comply with the chemical-, location-, and action-specific ARARs.

Long-term Effectiveness and Permanence

An on-site containment unit may require maintenance to ensure durability and continued leach-resistance of the treated material. Long-term protection can be ensured through continued maintenance of the containment system.

Reduction in Toxicity, Mobility, and/or Volume

Immobilization of the contaminants through chemical fixation reduces the bioavailability of the contaminants and thus their toxicity. The immobilization process may increase the volume of the material. Contaminant migration through erosion or storm water runoff is reduced or eliminated.

Short-term Effectiveness

Short-term exposures to Site workers would increase during the implementation of this alternative; however, health and safety procedures are available which would reduce the likelihood of short-term exposure. There may be short-term risks associated with this alternative due to the disturbance of the residue pile materials.

Implementability

The immobilization technology is widely implemented and reliable using commercially available reagents. The technology has been demonstrated and there is extensive vendor capacity. Containment is a commercially available, demonstrated technology. Necessary materials are easily attainable. The technology uses standard construction equipment and labor.

Cost

The estimated capital cost for Alternative 3 is $1,830,000. The net present value for Alternative 3 including 30 years of annual maintenance and CERCLA 5-year reviews is estimated to be $2,636,000.

4. Alternative 4 – On-Site Treatment of Leachable Residue Pile Materials Using Immobilization Technologies, Off-Site Disposal of Selected Residue Piles, and Institutional Controls

Overall Protection of Human Health and the Environment

Alternative 4 would be protective of human health and the environment at the Site as the residue pile materials that exhibited contaminant concentrations above the remediation goals would be transferred to secure off-site disposal facilities

Compliance with ARARs

Activities to be implemented under Alternative 4 would be conducted in such a manner to comply with the chemical-, location-, and action-specific ARARs.

Long-term Effectiveness and Permanence

Excavation and removal of residue pile materials is an effective alternative for reducing the long-term risk presented by the Site.

Reduction in Toxicity, Mobility, and/or Volume

Immobilization of the contaminants through chemical fixation reduces the bioavailability of the contaminants and thus their toxicity. The immobilization process may increase the volume of the material. Removal from the Site of selected residue pile materials that contain contaminants at concentrations above the Site remediation goals will reduce the toxicity, mobility, and volume of contaminants at the Site.

Short-term Effectiveness

Short-term exposures to Site workers would increase during the implementation of this alternative; however, health and safety procedures are available which would reduce the likelihood of short-term exposure. There will be short-term risks associated with this alternative due to the disturbance of the residue pile materials. There will be additional short-term risks due to the increased heavy equipment and truck traffic along the route from the Site to the landfills.

Implementability

The immobilization technology is widely implemented and reliable using commercially available reagents. The technology has been demonstrated and there is extensive vendor capacity. Containment is a commercially available, demonstrated technology. Necessary materials are easily attainable. The technology uses standard construction equipment and labor. The removal and transport of residue pile materials to off-site disposal facilities is technically feasible using readily available labor and equipment.

Cost

The estimated capital cost for Alternative 4 is $3,703,000. The net present value for Alternative 4 including 30 years of annual maintenance and CERCLA 5-year reviews is estimated to be $4,648,000.

5. Alternative 5 –Off-Site Disposal of Selected Residue Piles and Institutional Controls

Overall Protection of Human Health and the Environment

Alternative 5 would be protective of human health and the environment at the Site as the residue pile materials that exhibited contaminant concentrations above the remediation goals would be transferred to secure off-site disposal facilities.

Compliance with ARARs

Activities to be implemented under Alternative 5 would be conducted in such a manner to comply with the chemical-, location-, and action-specific ARARs.

Long-term Effectiveness and Permanence

Excavation and removal of selected residue pile materials that contain contaminants at concentrations above the remediation goals is an effective alternative for reducing the long-term risk presented by the Site.

Reduction in Toxicity, Mobility, and/or Volume

This alternative results in a reduction of toxicity, mobility, and/or volume at the Site by the removal from the Site of selected residue pile materials that contain contaminants at concentrations above the remediation goals.

Short-term Effectiveness

Short-term exposures to Site workers would increase during the removal operation; however, health and safety procedures are available, which would reduce the likelihood of short-term exposure. There will be short-term risks associated with this alternative due to the disturbance of the residue pile materials. There will be additional short-term risks due to the increased heavy equipment and truck traffic along the route from the Site to the landfills.

Implementability

The removal and transport of residue pile materials to off-site disposal facilities is technically feasible using readily available labor and equipment.

Cost

The estimated capital cost for Alternative 5 is $5,111,000. The net present value for Alternative 5 including 30 years of annual maintenance and CERCLA 5-year reviews is estimated to be $6,338,000.

VI. COMPARATIVE ANALYSIS OF ALTERNATIVES

The USEPA is required to select a remedy for the Site that meets the threshold criteria and best achieves the balancing criteria:

- **Overall Protection of Human Health and the Environment** – Alternative 1 does not meet this criterion. Alternatives 2 through 5 meet this criterion.

- **Compliance with ARARs** – Alternative 1 does not meet this criterion. Alternatives 2 through 5 meet this criterion.

- **Long-term Effectiveness and Permanence** – Alternative 1 does not meet this criterion. Alternatives 2 through 5 meet this criterion.

- **Reduction in Toxicity, Mobility, and/or Volume** – Alternative 1 does not meet this criterion. Reduction in toxicity, mobility and/or volume is not applicable to Alternative 2 under the current and reasonably anticipated use scenarios as there are no risks above the levels specified in the NCP. Under the hypothetical worst-case future use scenario as proposed by CH2M HILL, Alternative 2 would not achieve this criterion. Alternative 3 meets this criterion as immobilization of the contaminants through chemical fixation reduces the bioavailability of the contaminants and thus their toxicity. Alternative 4 and 5 meet this criterion as the residue pile materials that contain contaminant concentrations above the Site remediation goals are removed from the Site.

- **Short-term Effectiveness** – This criterion is not applicable to Alternative 1. Alternative 2 provides short-term effectiveness. Alternatives 3, 4 and 5 require implementation of appropriate health and safety plans to be effective in the short-term.

- **Implementability** – All of the alternatives are readily implementable.

- **Cost** – Alternative 1 has no costs. Alternative 2 is significantly less costly than Alternatives 3, 4, and 5 with comparable levels of protectiveness, but would not reduce the toxicity, mobility, and/or volume of the contaminants. Alternative 3 is significantly less costly than Alternatives 4 and 5 with a comparable amount of protectiveness. A comparison of the costs for the various alternatives is presented in Table VI-1.

VII. RECOMMENDED ALTERNATIVE

Based on the evaluation presented in Section VI above, both Alternatives 2 and 3 satisfy the threshold and balancing criteria. Given that Alternative 3 reduces the mobility of the contaminants, Alternative 3 - On-Site Treatment of Leachable Residue Pile Materials Using Immobilization Technologies, On-Site Containment of Selected Residue Piles, and Institutional Controls is recommended. Alternative 3 addresses the RAOs for the Site and potential risks to both human and ecological receptors. The weight of evidence approach presented in Section V indicates that Alternative 3 is the best overall alternative for the residue pile materials at the Site. Alternative 3 includes immobilization of the lead in selected residue pile materials (piles MP1-21, RR2-11, and RR1-3), consolidation and on-site containment of those residues piles that contain contaminant concentrations above the Site remediation goals (piles MP1-21, RR2-11, RR1-3, and RCO-10), and institutional controls to insure that the remedy is protective of human health and the environment. Alternative 3 is the least costly alternative that satisfies the preference for treatment or removal of contaminants and affords a comparable amount of protectiveness.

VIII. REFERENCES

ENVIRON. 2005. *Remedial Investigation Report.* February.

ENVIRON. 2006. *Addendum to Remedial Investigation Report.* February.

USEPA. 1988a. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA.*

USEPA. 1988b. *CERCLA Compliance With Other Laws Manual.*

USEPA. 1999. Presumptive Remedies for "Principal Threat" wastes at metals-in-soil sites

USEPA. 2002. *Blood Lead Concentrations of U.S. Adult Females: Summary Statistics from Phases I and II of the National Health and Nutrition Evaluation Survey (NHANES III).* Office of Solid Waste and Emergency Response. OSWER # 9285.7-52.

USEPA. 2005a. EPA comment letter dated December 22, 2005.

USEPA. 2005b. Region 3 Risk-Based Concentration Tables, October 2005 update (http://www.epa.gov/reg3hwmd/risk/human/index.htm).

TABLES

Table III-1

Residue Pile Analytical Results

Eagle Zinc Company Site
Hillsboro, Illinois

	Sample ID	CPH-6		CPH-9		MP1-21		NP-13		NP-14		NP-15		NP-16		RCO-10		RCO-5		RRO-12D		RRO-12		RR1-1		RR1-2		RR1-3		RR1-4		RR2-11	
Parameter	**Remediation Objective[1]**																																
Arsenic	39	33	J	8.1	J	200		5.7	J	3.1	J	11	J	12	J	41	J	19	J	15		11	J	9.1		6.8		16	J	7.9	J	21	J
Lead	1,288	800		79		31,000		76		74		1,200		550		2,500		530		520		810		450		250		1,600		120		7,700	
TCLP Lead (mg/L)	5.0	--		0.2		**83**		0.2		0.23		0.2		0.2		0.86		0.2		--		0.2		0.35		0.2		**14**		0.2		**6**	

Notes:

Only those parameters that have concentrations that are greater than the remediation objectives are presented in this table.
See the RI Report and RI Addendum for additional analytical results.
All concentrations are in milligrams per kilogram (mg/kg) unless otherwise noted.
TCLP = Toxicity Characteristic Leaching Procedure
mg/L = milligrams per liter
-- = Sample not analyzed
Shaded/colored boxing indicates concentration exceeds Remediation Objective for the Site.
J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the samples.

[1] See discussion in Section III of the FS Report for development of arsenic and lead remediation objectives.

Table III-2
Potential Chemical-Specific ARARs and TBCs

Eagle Zinc Company Site
Hillsboro, Illinois

Statute/Regulation Citation	ARAR or TBC	Summary
Illinois Groundwater Protection Act 35 IAC 602	ARAR	Provides numerical standards and groundwater classification
Water Quality Standards 35 IAC 302 Subparts B and D	ARAR	Provides Illinois surface water standards
Federal Ambient Water Quality Criteria CWA 40 CFR 131	ARAR	Establishes methods and requirements for states in the development of ambient water quality criteria for the protection of aquatic organisms and/or the protection of human health in surface water.
Resource Conservation and Recovery Act (RCRA) 40 CFR Part 260-270	ARAR	Establishes provisions covering USEPA permitting requirements, and establishes toxicity characteristics for hazardous waste.
Region 3 Risk-Based Concentrations	TBC	USEPA Region 3 risk-based tools for evaluating and cleaning up contaminated sites.
Illinois Tiered Approach to Corrective Action 35 IAC 742	TBC	Provides Illinois risk-based remediation objectives

Table III-3
Potential Location-Specific ARARs and TBCs

Eagle Zinc Company Site
Hillsboro, Illinois

Statute/Regulation Citation	ARAR or TBC	Summary
Endangered Species Act 16 USC 1531-1544, 50 CFR 200, 50 CFR 402	ARAR	The purpose of this act is to conserve endangered, threatened, and rare species of wildlife and plants. This regulation prohibits federal agencies from jeopardizing habitat for endangered or threatened species.
Wetlands Protection [Executive Order 11990] 40 CFR 6.302, Appendix A	ARAR	Regulates action involving construction of facilities or management of property in wetlands to avoid adverse effects, minimize potential harm, and preserve and enhance wetlands, to the extent possible.
Federal Floodplain Management [Executive Order 11988] 40 CFR 6.302, Appendix A	ARAR	Regulates actions that will occur in floodplain to avoid adverse effects due to flooding.
National Historic Preservation Act Executive Order 11593 40 CFR 6.301(b)	ARAR	Requires federal agencies to take into account the effect of any federally-assisted undertaking or licensing on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register of Historic Places. Provides for protection, enhancement, and preservation of sites with archeological or historical significance.

Table III-4
Potential Action-Specific ARARs and TBCs

Eagle Zinc Company Site
Hillsboro, Illinois

Statute/Regulation Citation	ARAR or TBC	Summary
Resource Conservation and Recovery Act (RCRA) 40 CFR Part 260-270	ARAR	Establishes provisions covering USEPA permitting requirements, and establishes toxicity characteristics for hazardous waste.
Occupational Safety and Health Act 29 CFR Part 1910	ARAR	Protects worker health and safety
Clean Water Act, National Pollutant Discharge Elimination System (NPDES) CWA 40 CFR 122	ARAR	Regulates discharges of pollutants to surface waters.
Clean Air Act 42 USC 7401-7671, 40 CFR 50, 40 CFR 61	ARAR	Protects ambient air quality through pollutant source control. It establishes National Ambient Air Quality Standards (NAAQS) and National Emission Standards for Hazardous Air Pollutants (NESHAP).
DOT Regulations 49 CFR 171, 172, 173, 179	ARAR	Provides transportation and handling requirements for hazardous materials
USEPA Remedial Design/Remedial Action Handbook	TBC	General reference manual that provides remedial project managers with an overview of the remedial design and remedial action processes.
USEPA Superfund Remedial Design and Remedial Action Guidance	TBC	Guidance document developed to assist agencies and parties who plan, administer, and manage remedial design and remedial action processes.
IEPA - Site Remediation Program 35 IAC Subtitle G, Chapter I, Part 740	TBC	Establishes procedures for the investigative and remedial activities at sites where there is a release, threatened release, or suspected release of hazardous substances, pesticides, or petroleum and for the review and approval of those activities.

Table VI-1
Comparison of Alternative Costs

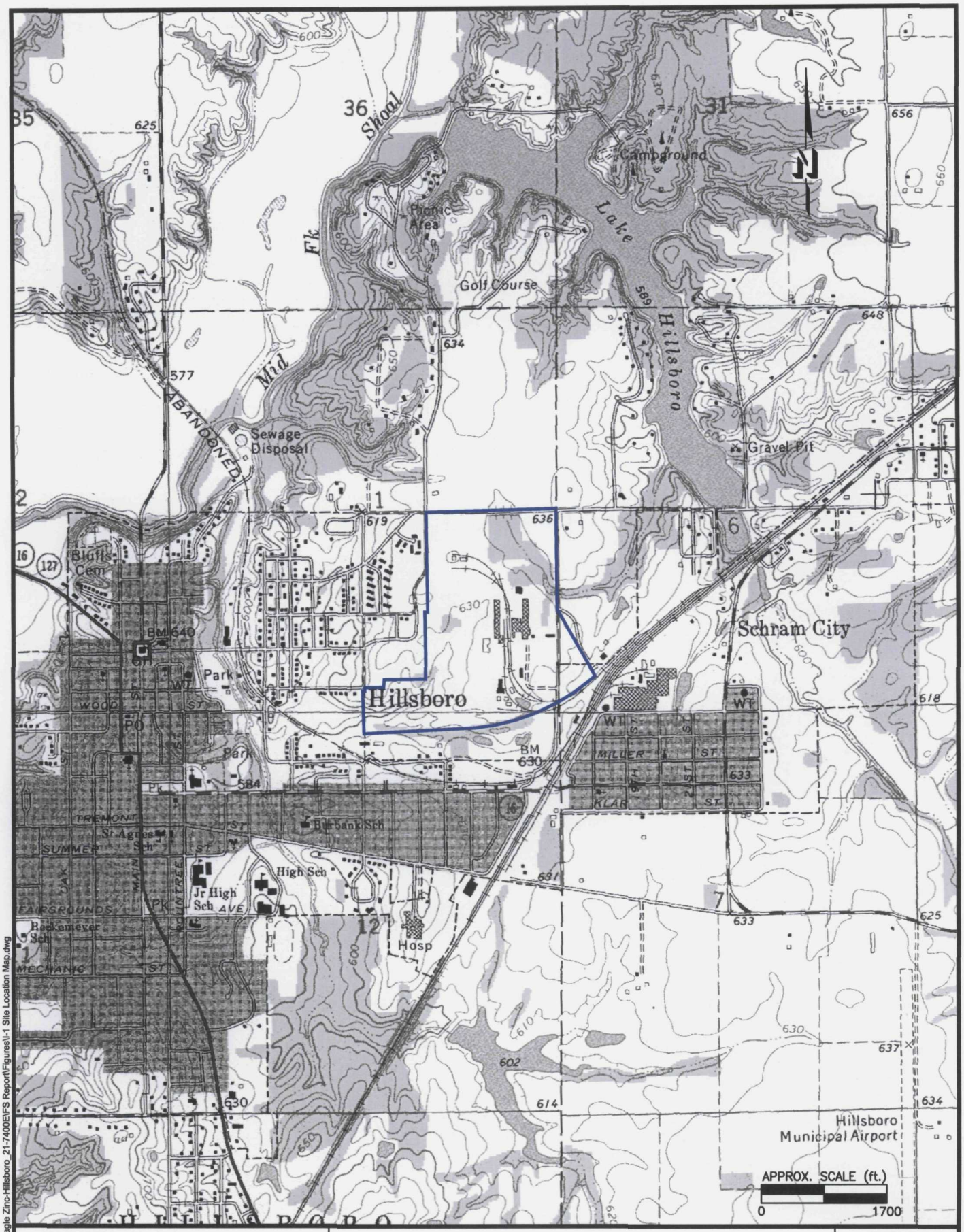
Eagle Zinc Company Site
Hillsboro, Illinois

	Individual Alternatives				
	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 4**	**Alternative 5**
Capital Costs	$0	$201,000	$1,830,000	$3,703,000	$5,111,000
NPV of Annual O&M Costs and 5-yr Reviews	$0	$170,000	$366,000	$170,000	$170,000
Subtotal Net Present Value	**$0**	**$371,000**	**$2,196,000**	**$3,873,000**	**$5,281,000**
Total with 20% Contingency	**$0**	**$446,000**	**$2,636,000**	**$4,648,000**	**$6,338,000**

Notes:

Net present value (NPV) calculated assuming 3% discount rate and performance period of 30 years.
Total NPV includes sum of capital costs, annual O&M costs NPV, and periodic costs NPV associated with each alternative.

FIGURES



ENVIRON

SITE LOCATION MAP
EAGLE ZINC COMPANY SITE
HILLSBORO, ILLINOIS

Figure
I-1

Drafter: APR Date: 04/11/05 Contract Number: 21-7400E Approved: Revised:

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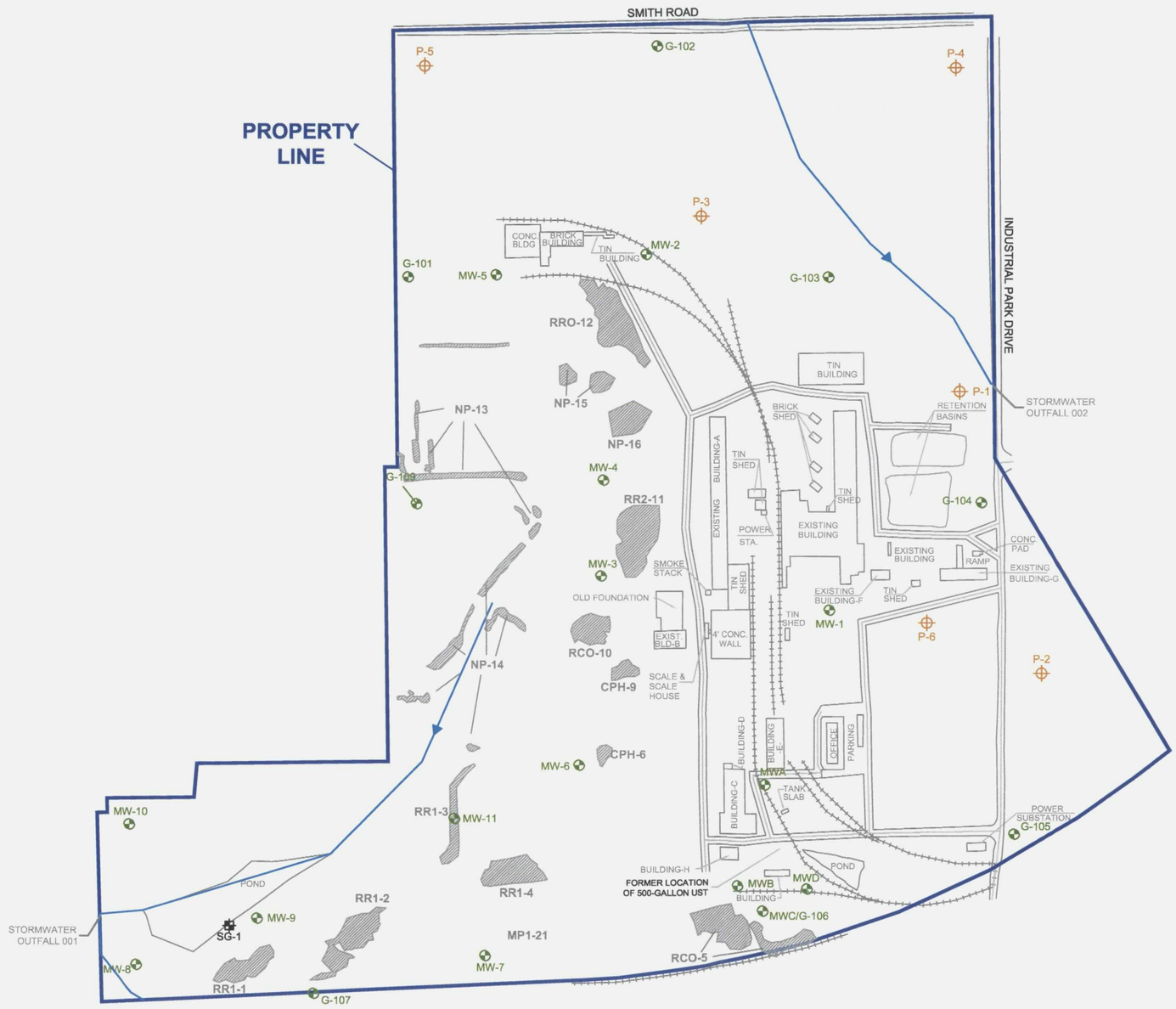

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LEGEND

- MONITORING WELL
- PIEZOMETER
- STAFF GAUGE
- STREAMS/DRAINAGEWAYS
- STORM WATER/SURFACE WATER FLOW
- RESIDUE PILES
  - RR1 = ROTARY RESIDUE TYPE 1
  - RR2 = ROTARY RESIDUE TYPE 2
  - RCO = ROTARY CLEAN OUT
  - RRO = ROTARY RESIDUE OVERSIZE
  - CPH = CARBON PLANT HUTCH
  - MP = MISCELLANEOUS PILES
  - NP = NEWLY IDENTIFIED PILES

APPROX. SCALE (ft.)

0 360

ENVIRON

SITE LAYOUT MAP
EAGLE ZINC COMPANY SITE
HILLSBORO, ILLINOIS

DATE:	CONTRACT NUMBER:		FIGURE
04/11/05	21-7400E		I-2
DRAFTER: APR	APPROVED:	REVISED: 03/16/06	

MW-5	Class I (mg/L)	Class II (mg/L)	Total (mg/L)	Dissolved (mg/L)
Manganese	*0.15*	*10*	0.15	**0.17**

G-102	Class I (mg/L)	Class II (mg/L)	Total (mg/L)	Dissolved (mg/L)
Manganese	*0.15*	*10*	**0.29**	**0.29**

MW-1	Class I (mg/L)	Class II (mg/L)	Total (mg/L)	Dissolved (mg/L)
Sulfate	*400*	*400*	**530**	NA
Thallium	*0.002*	*0.02*	**0.0043J**	ND

G-104	Class I (mg/L)	Class II (mg/L)	Total (mg/L)	Dissolved (mg/L)
Iron	*5*	*5*	**110**	ND
Lead	*0.0075*	*0.1*	**0.079**	ND
Vanadium	*0.049*	*--*	**0.11**	ND
Manganese	*0.15*	*10*	**2.2**	0.018

G-109	Class I (mg/L)	Class II (mg/L)	Total (mg/L)	Dissolved (mg/L)
Iron	*5*	*5*	**210**	ND
Lead	*0.0075*	*0.1*	**0.15**	ND
Arsenic	*0.05*	*0.2*	**0.075**	ND
Beryllium	*0.004*	*0.5*	**0.008**	ND
Chromium	*0.1*	*1*	**0.17**	0.0014
Vanadium	*0.049*	*--*	**0.2**	ND
Manganese	*0.15*	*10*	**8.1**	0.016
Nickel	*0.1*	*2*	**0.23**	ND

MW-4	Class I (mg/L)	Class II (mg/L)	Total (mg/L)	Dissolved (mg/L)
Antimony	*0.006*	*0.024*	**0.01**	ND
Iron	*5*	*5*	**49**	ND
Lead	*0.0075*	*0.1*	**0.93**	0.0015
Cadmium	*0.005*	*0.05*	**0.082**	0.00071
Copper	*0.65*	*0.65*	**0.95**	ND
Vanadium	*0.049*	*--*	**0.096**	ND
Zinc	*5*	*10*	**210**	ND
Manganese	*0.15*	*10*	**1.4**	**0.78**
Nickel	*0.1*	*2*	**0.15**	0.0026

MW-10	Class I (mg/L)	Class II (mg/L)	Total (mg/L)	Dissolved (mg/L)
Iron	*5*	*5*	**130**	0.28
Lead	*0.0075*	*0.1*	**0.08**	ND
Arsenic	*0.05*	*0.2*	**0.058**	ND
Beryllium	*0.004*	*0.5*	**0.0066**	ND
Chromium	*0.1*	*1*	**0.16**	0.0028
Vanadium	*0.049*	*--*	**0.19**	ND
Manganese	*0.15*	*10*	**2.8**	0.014
Nickel	*0.1*	*2*	**0.14**	0.0025

MW-3	Class I (mg/L)	Class II (mg/L)	Total (mg/L)	Dissolved (mg/L)
Sulfate	*400*	*400*	**730**	NA

MW-11	Class I (mg/L)	Class II (mg/L)	Total (mg/L)	Dissolved (mg/L)
Manganese	*0.15*	*10*	**0.34**	**0.42**

MW-8	Class I (mg/L)	Class II (mg/L)	Total (mg/L)	Dissolved (mg/L)
Lead	*0.0075*	*0.1*	**0.13**	**0.018**
Cadmium	*0.005*	*0.05*	**0.031**	**0.025**
Zinc	*5*	*10*	**13**	**13**

TW-7	Class I (mg/L)	Class II (mg/L)	Total (mg/L)	Dissolved (mg/L)
Iron	*5*	*5*	**22**	0.51
Lead	*0.0075*	*0.1*	**0.019**	0.00019
Manganese	*0.15*	*10*	**1.5**	**1.4**

TW-6	Class I (mg/L)	Class II (mg/L)	Total (mg/L)	Dissolved (mg/L)
Iron	*5*	*5*	**81**	1.2
Lead	*0.0075*	*0.1*	**0.092**	0.00022
Manganese	*0.15*	*10*	**4.5**	**2.8**
Nickel	*0.1*	*2*	**0.14**	0.011
Vanadium	*0.049*	*--*	**0.12**	0.0023

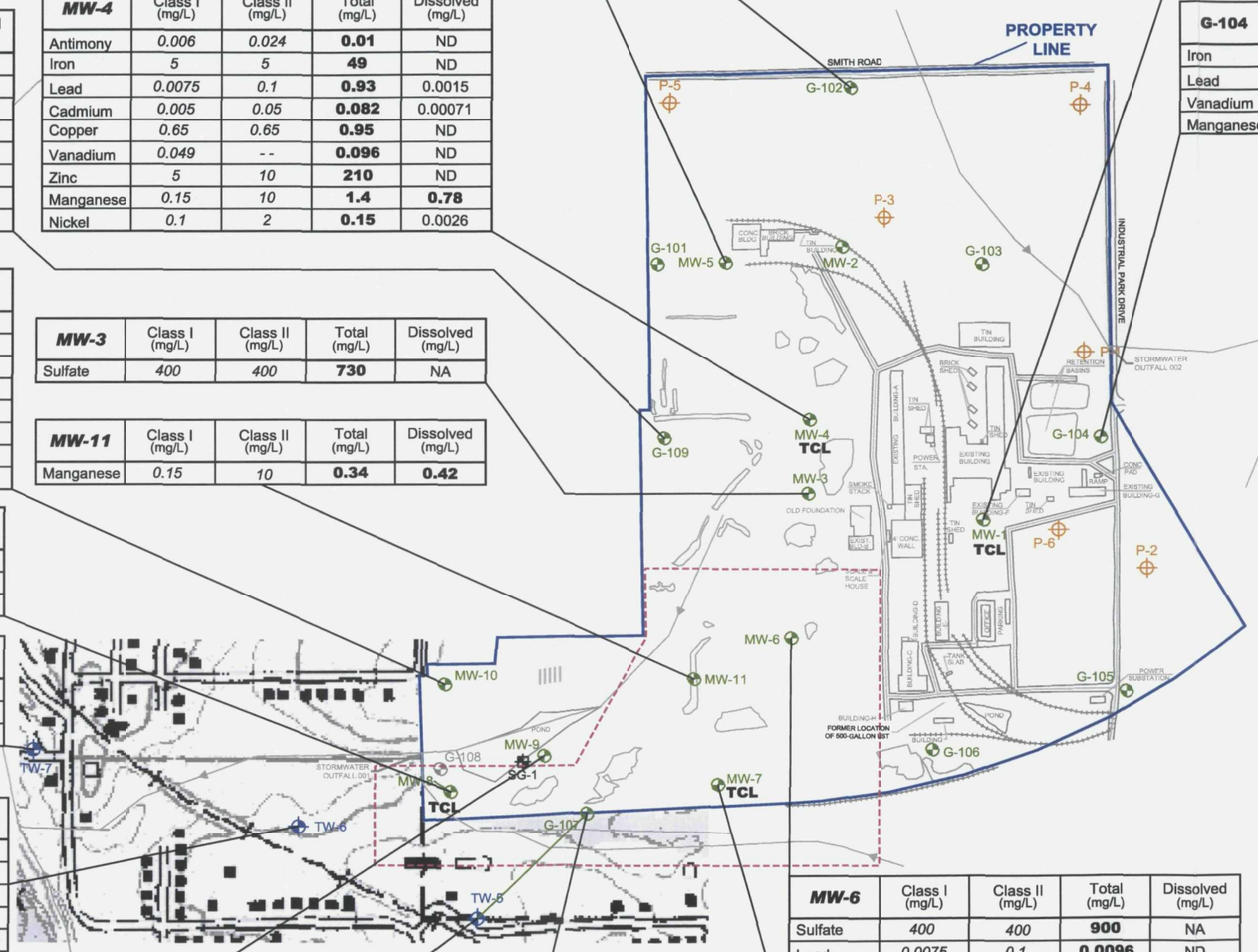
MW-9	Class I (mg/L)	Class II (mg/L)	Total (mg/L)	Dissolved (mg/L)
Sulfate	*400*	*400*	**1,700**	NA
Manganese	*0.15*	*10*	**0.92**	**1**

TW-5	Class I (mg/L)	Class II (mg/L)	Total (mg/L)	Dissolved (mg/L)
Iron	*5*	*5*	**17**	0.62
Lead	*0.0075*	*0.1*	**0.017**	0.00027
Manganese	*0.15*	*10*	**1.3**	**1.0**

G-107	Class I (mg/L)	Class II (mg/L)	Total (mg/L)	Dissolved (mg/L)
Sulfate	*400*	*400*	**920**	NA
Iron	*5*	*5*	**11**	**9.5**
Lead	*0.0075*	*0.1*	**0.061**	0.0068
Cadmium	*0.005*	*0.05*	**0.061**	**0.035**
Zinc	*5*	*10*	**19**	**17**
Manganese	*0.15*	*10*	**1.1**	**1.2**

MW-6	Class I (mg/L)	Class II (mg/L)	Total (mg/L)	Dissolved (mg/L)
Sulfate	*400*	*400*	**900**	NA
Lead	*0.0075*	*0.1*	**0.0096**	ND
Cadmium	*0.005*	*0.05*	**0.086**	**0.079**
Manganese	*0.15*	*10*	**0.87**	**0.94**

MW-7	Class I (mg/L)	Class II (mg/L)	Total (mg/L)	Dissolved (mg/L)
Sulfate	*400*	*400*	**720**	NA
Thallium	*0.002*	*0.02*	ND	**0.0074**
Cadmium	*0.005*	*0.05*	**0.39**	**0.33**
Zinc	*5*	*10*	**120**	**120**
Manganese	*0.15*	*10*	**12**	**13**



LEGEND

- MONITORING WELL
- TCL — SAMPLE ANALYZED FOR TCL ORGANICS AND PCBS IN ADDITION TO TAL METALS AND SULFATES
- TEMPORARY MONITORING WELL
- PERMANENT PIEZOMETER
- WELL ABANDONED IN MARCH 2003
- STAFF GAUGE
- STREAMS/DRAINAGEWAYS
- STORM WATER/SURFACE WATER FLOW
- APPROXIMATE LIMITS OF GROUNDWATER PAOC

NOTE: CONCENTRATIONS ABOVE SCREENING LEVELS (ILLINOIS GROUNDWATER PROTECTION ACT STANDARDS FOR CLASS I GROUNDWATER) ARE SHOWN IN **BOLD** TYPE.

NA = NOT APPLICABLE
ND = NOT DETECTED
-- = NO STANDARD
mg/L = MILLIGRAMS PER LITER

APPROX. SCALE (ft.)
0 550

ENVIRON

GROUNDWATER EXCEEDANCES OF ILLINOIS GROUNDWATER PROTECTION ACT STANDARDS
EAGLE ZINC COMPANY SITE
HILLSBORO, ILLINOIS

DATE:	CONTRACT NUMBER:		FIGURE
04/11/05	21-7400E		III-1
DRAFTER: APR	APPROVED:	REVISED: 03/17/06	

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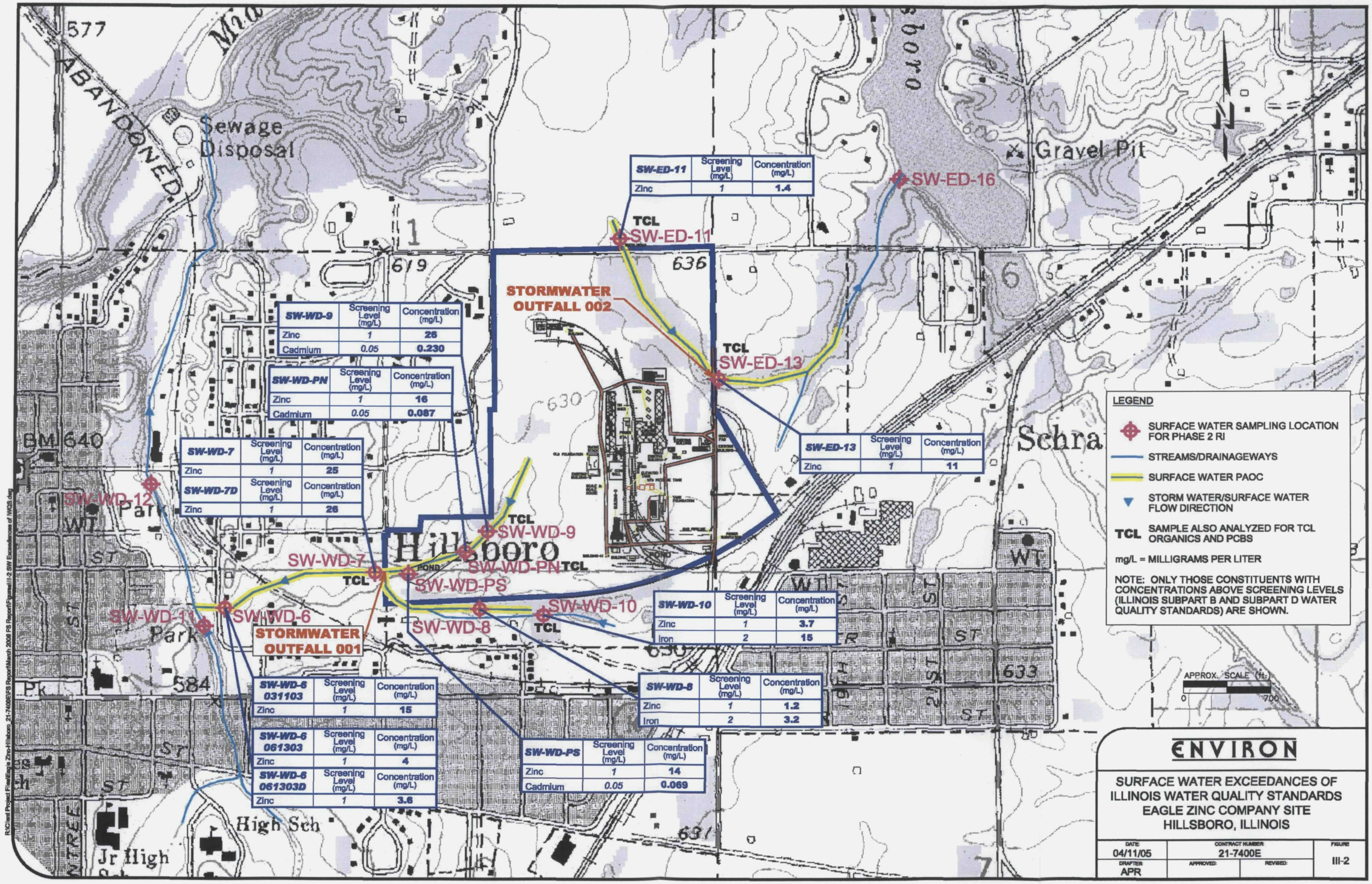
ABANDONED
Sewage Disposal
Gravel Pit
Schra
Hillsboro
POND
STORMWATER OUTFALL 002
STORMWATER OUTFALL 001
TCL
SW-ED-11
SW-ED-16
SW-ED-13
SW-WD-12
SW-WD-11
SW-WD-7
SW-WD-6
SW-WD-PN
SW-WD-PS
SW-WD-9
SW-WD-8
SW-WD-10
BM 640
Park
High Sch
Jr High
SW-ED-11 | Screening Level (mg/L) | Concentration (mg/L)
Zinc | 1 | 1.4
SW-WD-9 | Screening Level (mg/L) | Concentration (mg/L)
Zinc | 1 | 25
Cadmium | 0.05 | 0.230
SW-WD-PN | Screening Level (mg/L) | Concentration (mg/L)
Zinc | 1 | 16
Cadmium | 0.05 | 0.087
SW-WD-7 | Screening Level (mg/L) | Concentration (mg/L)
Zinc | 1 | 25
SW-WD-7D | Screening Level (mg/L) | Concentration (mg/L)
Zinc | 1 | 26
SW-ED-13 | Screening Level (mg/L) | Concentration (mg/L)
Zinc | 1 | 11
SW-WD-10 | Screening Level (mg/L) | Concentration (mg/L)
Zinc | 1 | 3.7
Iron | 2 | 15
SW-WD-8 | Screening Level (mg/L) | Concentration (mg/L)
Zinc | 1 | 1.2
Iron | 2 | 3.2
SW-WD-6 031103 | Screening Level (mg/L) | Concentration (mg/L)
Zinc | 1 | 15
SW-WD-6 061303 | Screening Level (mg/L) | Concentration (mg/L)
Zinc | 1 | 4
SW-WD-6 061303D | Screening Level (mg/L) | Concentration (mg/L)
Zinc | 1 | 3.6
SW-WD-PS | Screening Level (mg/L) | Concentration (mg/L)
Zinc | 1 | 14
Cadmium | 0.05 | 0.069
LEGEND
SURFACE WATER SAMPLING LOCATION FOR PHASE 2 RI
STREAMS/DRAINAGEWAYS
SURFACE WATER PAOC
STORM WATER/SURFACE WATER FLOW DIRECTION
TCL SAMPLE ALSO ANALYZED FOR TCL ORGANICS AND PCBS
mg/L = MILLIGRAMS PER LITER
NOTE: ONLY THOSE CONSTITUENTS WITH CONCENTRATIONS ABOVE SCREENING LEVELS (ILLINOIS SUBPART B AND SUBPART D WATER QUALITY STANDARDS) ARE SHOWN.
APPROX. SCALE (ft.)
0
700
ENVIRON
SURFACE WATER EXCEEDANCES OF ILLINOIS WATER QUALITY STANDARDS
EAGLE ZINC COMPANY SITE
HILLSBORO, ILLINOIS
DATE: 04/11/05
CONTRACT NUMBER: 21-7400E
FIGURE: III-2
DRAFTER: APR
APPROVED:
REVISED:
R:\Client Project Files\Eagle Zinc-Hillsboro_21-7400E\PS Report\March 2006 PS Report\Figure III-2 SW Exceedances of WQS.dwg

APPENDIX A

Arsenic Remediation Goal Verification

APPENDIX A
Arsenic Remediation Goal Verification

In General:

$$CR = \left(\frac{C_S \times EF \times ED}{BW \times AT}\right) \times \left\{\left(IR_S \times SF_O \times 10^{-6}\ kg/mg\right) + \left(\frac{IR_a \times SF_i}{PEF}\right) + \left(SA \times AF \times ABS \times SF_O \times 10^{-6}\ kg/mg\right)\right\}$$

Therefore:

$$CR = \left(\frac{39\ mg/kg \times 250\ d/yr \times 25\ yr}{70\ kg \times (70\ yr \times 365\ d/yr)}\right) \times \left\{\begin{array}{l}\left(50\ mg/d \times 1.5\ kg\text{-}d/mg \times 10^{-6}\ kg/mg\right) + \left(\frac{20\ m^3/d \times 15\ kg\text{-}d/mg}{1.36 \times 10^9\ m^3/kg}\right) \\ + \left(3{,}300\ cm^2/d \times 0.2\ mg/cm^2 \times 0.03 \times 1.5\ kg\text{-}d/mg \times 10^{-6}\ kg/mg\right)\end{array}\right\}$$

$$CR = 1 \times 10^{-5}$$

Where:

Exposure Variable	Description of Exposure Variable	Values	Units	Reference
CR	Cancer Risk	--	unitless	Calculated
C_s	Concentration in Soil	--	mg/kg	Calculated or Measured
EF	Exposure Frequency	250	days/year	USEPA 2002
ED	Exposure Duration	25	years	USEPA 2002
BW	Body Weight	70	kg	USEPA 2002
AT	Averaging Time	ED x 365	days/year	
IR_s	Ingestion Rate	50	mg/day	USEPA 2002
SF_o	Oral Slope Factor	1.5	kg-day/mg	USEPA 2006
IR_a	Inhalation Rate	20	m^3/day	USEPA 2002
SF_i	Inhalation Slope Factor	15	kg-day/mg	USEPA 2006
PEF	Particulate Emission Factor	1.36 x 10^9	m^3/kg	USEPA 2002
SA	Surface Area	3,300	cm^2/day	USEPA 2004
AF	Adherence Factor	0.2	mg/cm^2	USEPA 2004
ABS	Dermal Absorption from Soil	0.03	unitless	USEPA 2004

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